Answers to the final questions sent on October 10th, 2016

"Dear Mohammad,

After consultation of Raphael (who contacted you), the CAN review committee would like to request that the study of varying cut in the missing energy eHe4gX be repeated with a proper, bin dependent, pi0 subtraction. We understand that this may take several days, but feel it is a necessary step to raise any doubt about the stability of the result. Optionally, if time allows, add a fourth cut which would only get rid of the tails: [-0.45, 0.50].

I also discussed with Raphael the necessity to explain in the section on Systematic uncertainties how the corresponding numbers in the numerical tables are generated. So far, the discussion is exclusively on the fitted ALU(90°), while the numbers in the Tables are bin-dependent.

Thank you and best regards,

Michel."

1. Regarding the stability of the coherent A_{LU} with respect to the missing energy cut. We first remind the previous exchange from the first round comments and the results we got. Then, we present the new study after the CAN review committee suggestion.

   (a) The first round comment, where the background subtraction have been performed based on the 4D background subtractions without binning in the missing energy distribution:
   " 40) Fig. 4.2: I'm bothered by the wide distribution in Emiss (top middle), and don't understand why you use such wide cuts. Surely, anything above Emiss = 0.4 must have additional particles in it, and even if not, why not cut this tail? Note that the same tail is absent for the p (Fig. 4.6) where you use indeed a tighter cut, although you don't even account for the proton's initial momentum.
   We applied 3σ based on the comparison between data and simulation, see figure 4.4 in the note. In the following, figure 1, we performed bins in the missing energy distribution and we watch the reconstructed beam-spin asymmetries. As a conclusion, we see that the reconstructed asymmetries are compatible within the given error bars."

   (b) Following the CAN committee suggestion, we performed this study again recalculating the π^0 contamination for the different bins in the missing energy. The results are presented in figure 2. The high missing energy bin is the most affected and goes up, closer to the value from the central point. This is easily understood as this bin has a significantly higher π^0 contribution. In conclusion, the central bin remains with a stronger signal, however we want to point out that (i) this feature is not significant due to the large error bars in regard to the size of the effect and (ii) the variations are smaller than the 8% systematic error we evaluated from the rather arbitrary choice of exclusivity cuts. In conclusion, we believe that the cut is good as it is. The main reason being that statistical errors already dominate the error budget, so we think it would be counter productive to reduce even more our data sample in hope to reduce the systematic error.

   (c) Regarding the request of cutting the tails and comparing the reconstructed coherent asymmetries to the ones without cutting the tails, the asymmetries are presented in fig 3 as a function of ϕ in bins in Q^2, x_B and $-t$. The Q^2, x_B and $-t$ dependences of A_{LU} at $\phi = 90°$, from fitting the signals in fig 3, are presented in fig 4 with and without cutting the tails in the missing energy distribution. One can conclude that the two sets are compatible within the given error bars.

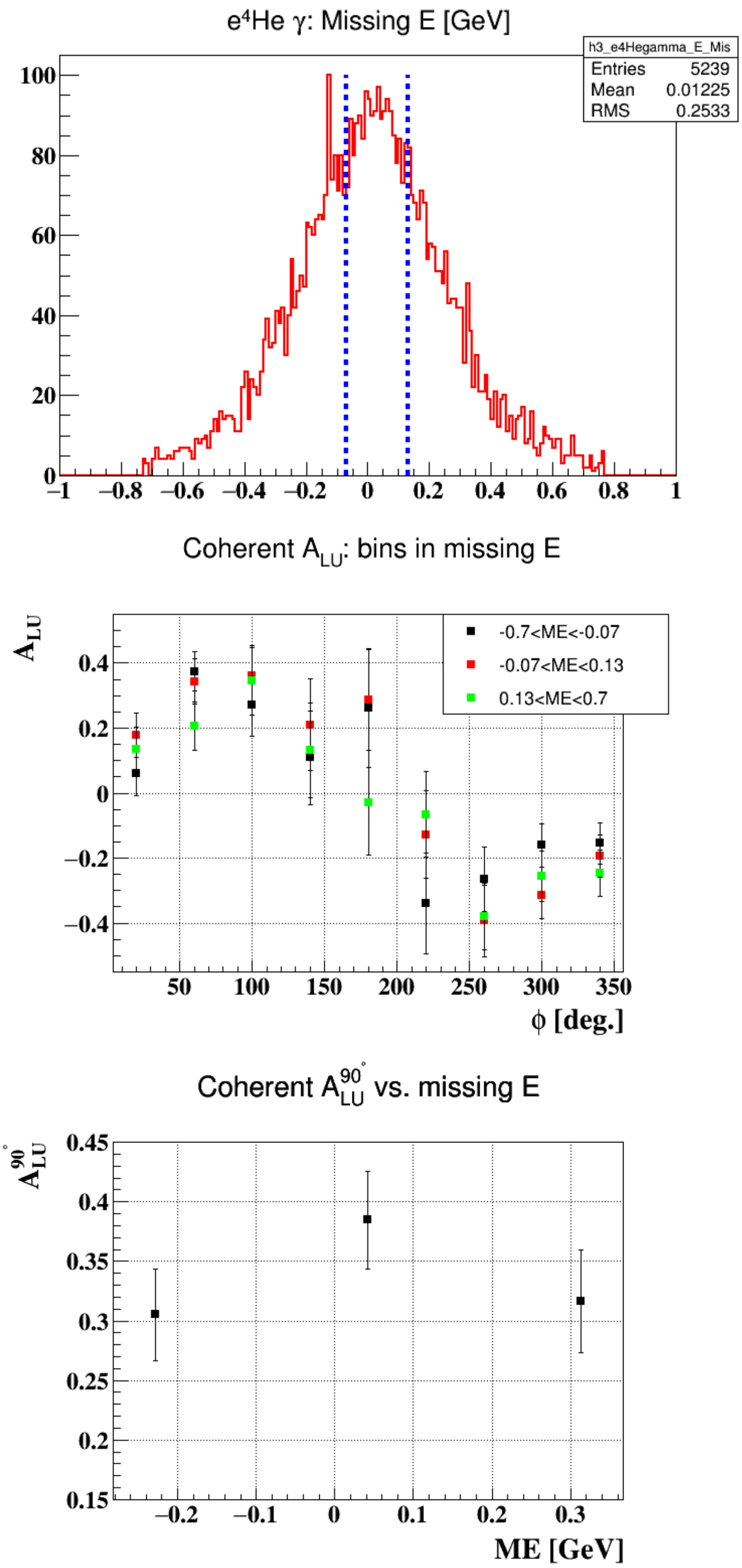

Figure 1: Coherent missing energy distributions (top), the reconstructed beam-spin asymmetries as a function of ϕ (middle), and the extracted asymmetry at $\phi = 90^{\circ}$ from fitting the asymmetries as a function of the missing energy in each bin.

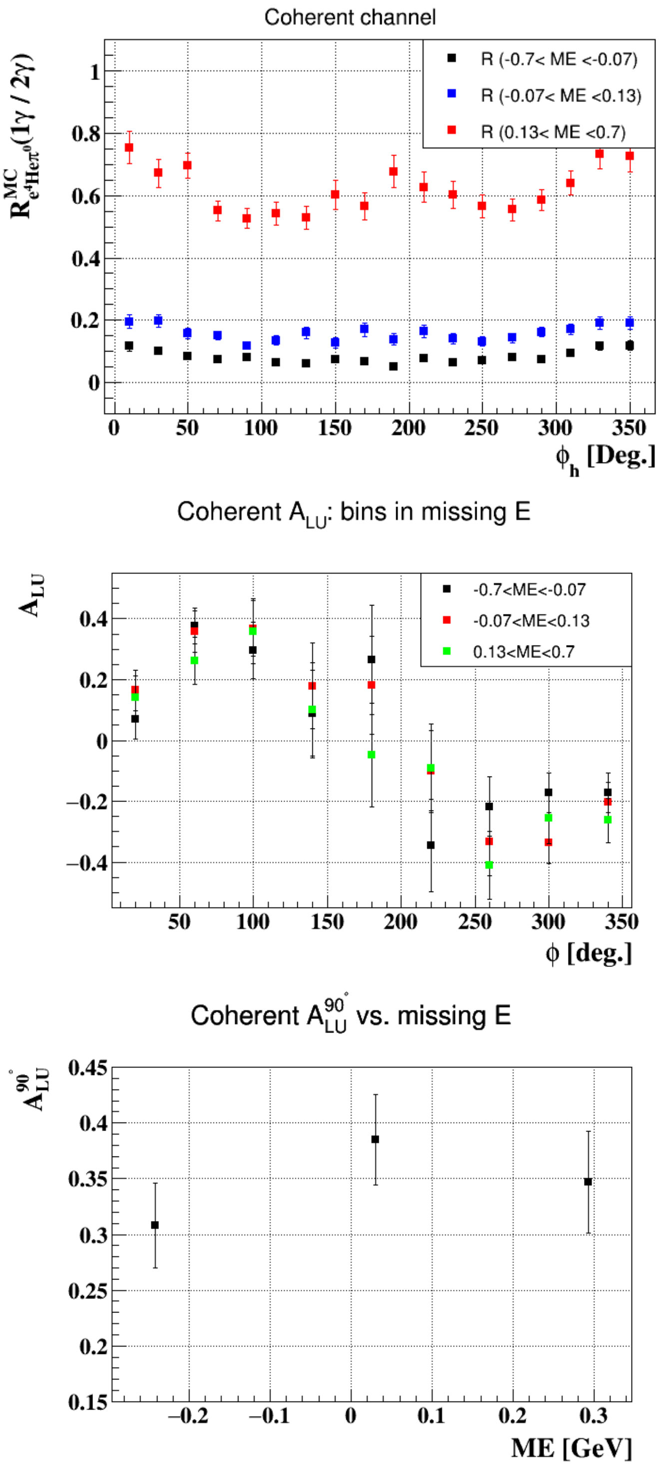

Figure 2: From top to bottom, the corresponding background acceptance ratio in the different missing energy bins, the reconstructed beam-spin asymmetries as a function of ϕ (middle), and the extracted asymmetry at $\phi = 90^\circ$ from fitting the asymmetries as a function of the mean missing energy in each bin.

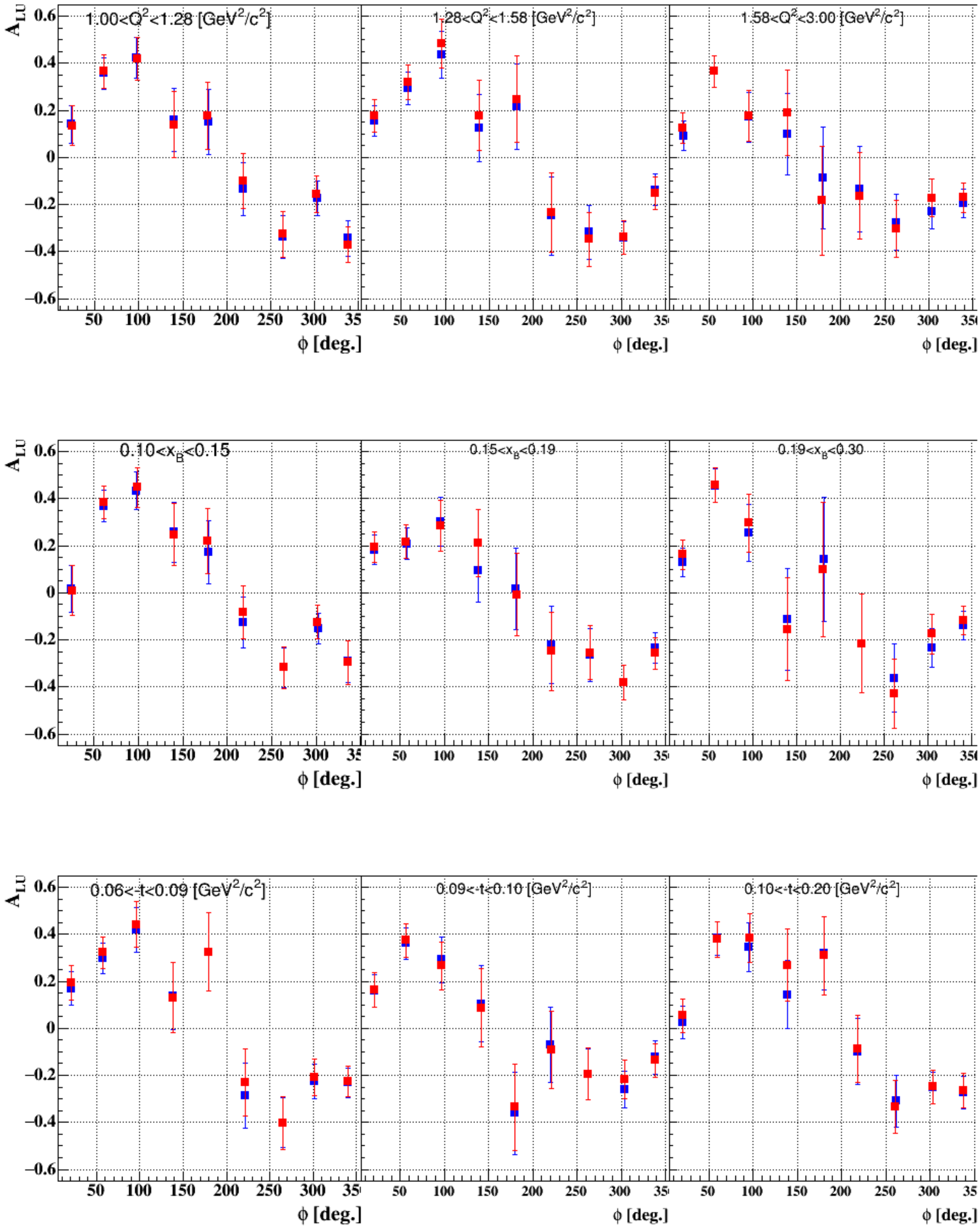

Figure 3: From top to bottom, the reconstructed beam-spin asymmetries as a function of $\phi = 90^\circ$ in Q^2, x_B and $-t$ with cutting the tails in red and without cutting the tails in blue.

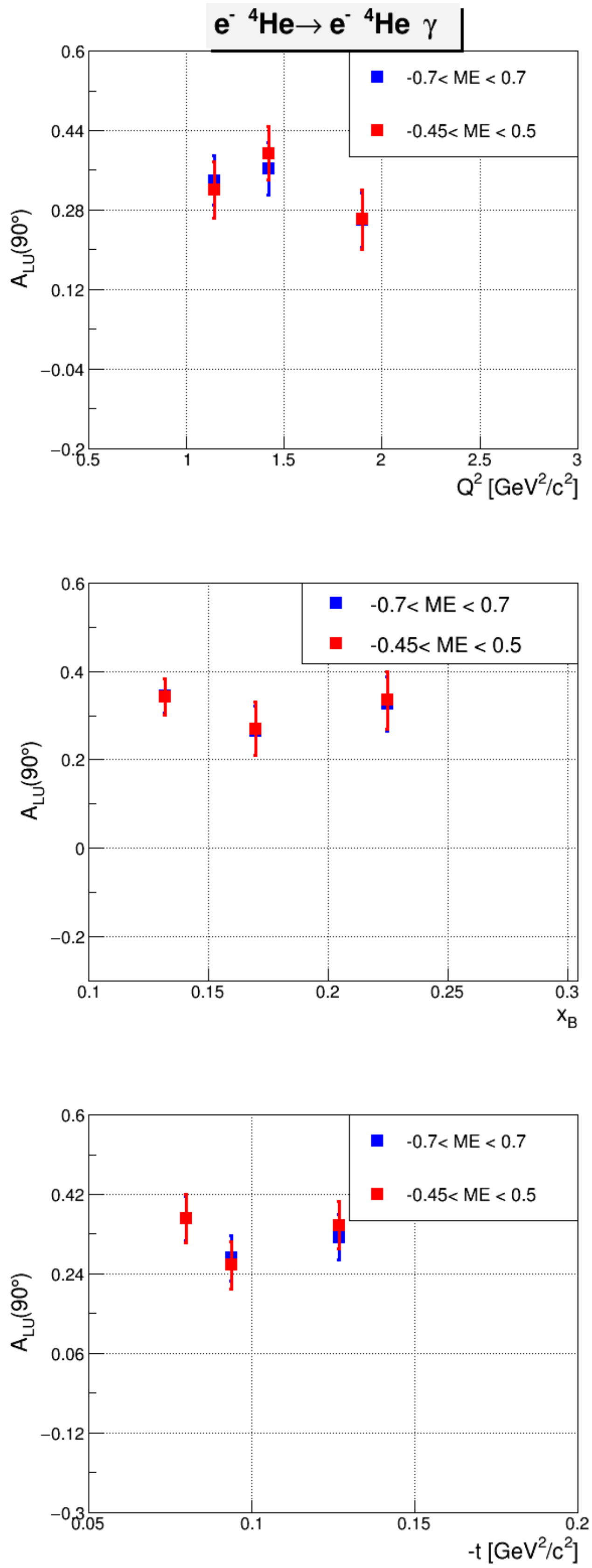

Figure 4: The extracted asymmetry at $\phi = 90^\circ$ from fitting the asymmetries in fig 3 as a function of Q^2, x_B and $-t$ with cutting the tails in red and without cutting the tails in blue.

2. Regarding the listed bin by bin systematic errors, they were extracted from the variation of the reconstructed asymmetries such as in figures 4.23 and 4.29 in the analysis note. The end of section 4.7 has been modified to include the following details on our error bar calculation:

   In addition to evaluating the systematic uncertainties on A_{LU} at $\phi = 90^\circ$, we performed bin by bin, in ϕ, extraction of these uncertainties. For instance, regarding the bin extraction from the source 'data binning' listed in table 4.2, the uncertainty is calculated as the difference between the two reconstructed asymmetries. Similar procedures have been carried out for the other studies, and finally all the contributions were added quadratically. These systematic uncertainties will be shown with the final asymmetry results in the following chapter.